US Army Corps
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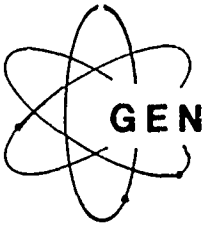
The Hydrologic
Engineering Center



GENERALIZED COMPUTER PROGRAM

HEC-5

Simulation of Flood Control and Conservation Systems

Simplified Version of Exhibit 8 of Users Manual

Input Description for Flood Control Operation of Single Event Floods

January 1986

10 December 1984

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EXHIBIT 8
HEC-5 INPUT DESCRIPTION

Scope of Manual

This manual was developed from the March 1985 Exhibit 8 by eliminating the input description for various cards and card fields not thought to be necessary for real time flood control operations. Any of the eliminated cards or card fields can be used in a real time simulation by modifying the data file using instructions from the complete March 1985 (or later) Exhibit 8 Manual. The following cards or card fields were eliminated from this manual:

	Whole Cards	Card Fields
Dynamic Dimensions	DM	
Economic Routines	J4, R$, C2, C$, DA-DC	
Evaporation	J6, RA, R3, EV	R2.3
Hydropower	SM, SD, SH, P1-PE, PV	BF.8
Low flow options	QM, MR	J2.4, CP.3, CP.4, CP.5
Multiflood options	R1, FC	BF.3, BF.9
Optimization	J7	J3.5
Other options		J1.1, J1.6-J1.10, J2.5, J2.7, R2.4
Plots		J3.3, C1.4
Reservoir Deletion	J5	
Trace options	TC, TP, TS	

This input description describes program capabilities through the March 1985 updates which deal with a single event flood operated for flood control. Full input capabilities are described in the full Exhibit 8 Manual. Data prepared using the 1979 user manuals should be converted to the current format.

This exhibit contains a detailed description of variables on each appropriate input card. A Functional Use Index that can be used to determine which input variables are required for specific tasks appears first. Following the Functional Use Index is a Table of Contents that provides a brief description of all appropriate HEC-5 data cards. The summary of input cards at the end of this exhibit shows the sequential arrangement of cards and also serves as a "table of contents" by showing, in Field 10, the page numbers where the variables are described in this exhibit.

Card Format

Variable locations for each input card are shown by field number. The cards are normally divided into ten fields of eight columns each except Field 1. Variables occurring in Field 1 may normally only occupy card columns 3-8 since card columns 1 and 2 are reserved for the required identification characters. The different values a variable may assume and the conditions for each are described for each variable. Some variables simply indicate whether a program option is to be used or not by using numbers such as -1, 0, 1. Other variables contain numbers which express the variable magnitude. For these a + sign is shown in the description under "value" and the numerical value of the variable is entered as input. Where the variable value is to be zero, the variable may be left blank since a blank field is read as zero.

If decimal points are not provided in the data, all numbers must be right justified in the field. Any number without a sign is considered positive.

Locations of variables on cards are sometimes referred to by an abbreviated designation, such as J1.4 representing the fourth field of the J1 card.

Related Programs

The use of the Hydrologic Engineering Center's (HEC) data storage system (HEC-DSS) and program INCRD for the specification of time series data is described in Section 6, entitled "Specifications for Time Series Data Cards", following the input description for the ED card.

Two other programs have recently been made available to use with HEC-5. User documentation is available from the HEC. The CKHEC5 program is a comprehensive input data checking program that performs essentially all of the checks that are possible given the knowledge of the problem furnished by the input data. It currently checks only cards J1-ED.

The INFIVE program is an interactive program designed to generate an HEC-5 input file containing the card images of all cards required to perform any job described by the user through a series of questions and answers.

EXHIBIT 8

HEC-5
FUNCTIONAL USE INDEX[1]

Task	Cards Used
1. BASIC APPLICATIONS	
a. Required Cards by Group	
(1) General Data	T1-T3, J1
(2) Reservoir Data	RL, RO, RS, RQ
(3) Control Point Data (including all reservoirs)	CP, ID, RT
(4) End of Control Point Data	ED
(5) Time Series (Flow) Data	BF, IN, EJ
(6) End of Run	ER
b. Variable Locations by Function (Basic Applications)	
(1) Diversions	RD-RS, DR, QS-QD, QD (after BF card)
(2) Natural Flow	J3.4, NQ
(3) Routing Data	J3.7, RT, CR, QS-SQ
(4) Number of Periods of Simulation	BF.2, BF.6
(5) Reservoir Level Data	J1, RL, CL, CG
(6) Print Options	J3.1, J8, JZ
(7) HEC-DSS (Data Storage System)	JZ, ID, ZW, ZR
(8) Comments in Data Set	C
2. Variable Locations for Flood Control Options	
(1) Forecasting Inflows	J2.1, R2.5
(2) Contingency Factor	J2.2, CP.6
(3) Maximum Rate of Change	J2.3, R2.1, R2.2
(4) Release Scheduling	J2.6
(5) Minimum Flood Control Releases	RD.1
(6) Hinge Pool Operation	R2.6, R2.7
(7) Surcharge Pool Elevations	RG.1, RG.2
(8) Induced Surcharge Envelope Curve Data	RG.3, RG.4, RD
(9) Gate Regulation Curve Options	RG
(10) Channel Capacity, Constant	CP.2
(11) Channel Capacity, Varies by Month	CC
(12) Channel Capacity, Varies by Season	CC and CS
(13) Channel Capacity, Varies by Flow at Another Location	CC and QS
(14) Channel Capacity, Varies with Reservoir Level (or Elevation)	CC and CL
(15) Channel Capacity, Varies with Season and Reservoir Level	CC, and CS and CG
(16) Channel Capacity, Varies with Season and Percent of Total System Flood Control Storage	CC, CS, GS and CG

[1]See Complete March 1985 (or later) Exhibit 8 for multiflood or non-flood control options.

HEC-5 DATA CARDS
TABLE OF CONTENTS

HEC-5 DATA CARDS
TABLE OF CONTENTS
(continued)

T1

T2

T3

C

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1 DOCUMENTATION CARDS

1.1 ** T1, T2, T3 CARDS - Job Title Cards

Job title cards. Three cards required. Both alphabetic and numeric information may be placed on these cards. Information on these cards will normally be printed out as job title on the first page of the output.

1.2 * C CARD - Comment Cards

Optional comment cards (C in Column 1 and blank in Column 2) can be used before the T1 card or anywhere within the HEC-5 data deck (ahead of BF card) to provide documentation of the input data. The comment card is printed along with the input listing from subroutine PRERD.

1.3 * -- CARDS - Variable Description Cards

Optional cards with columns 1 and 2 blank (for card identification), can be used anywhere within the HEC-5 data deck prior to the BF card. These cards can be created by use of the interactive input generation program INFIVE. The cards with the blank ID will not be printed in the input listing whereas comment cards (C in column 1) will be printed.

**Required cards
* Optional card

2 JOB CARDS (J1-JZ) - General Data Applying to Current JOB (Cards T1-EJ)

2.1 ** J1 CARD - First Job Card - Storage Allocation and Units

FIELD	VARIABLE	VALUE	DESCRIPTION
1	METRIC	0	Default units are English.
2	ISTMO	+	Starting month (1 = January) for all monthly data (within data cards T1-ED), such as storage levels (RL cards), diversions (QD card). Flow data on IN cards does not have to start with this same month.
3	NULEV	+	Number of index levels used in specifying storages for project purposes and in apportioning reservoir releases among reservoirs (see Exhibit 3). Minimum of 2; maximum of 15. Normally 5 levels are used, where Level 1 = Top of Inactive; Level 2 = Top of Buffer; Level 3 = Top of Conservation; Level 4 = Top of Flood Control; and, Level 5 = Top of Dam.
4	LEVCON	+	Index level on RL cards (Index L of array STORL (M,L,K)) corresponding to the top of the conservation pool for all reservoirs. Normally = 3.
5	LEVTFC	+	Index level on RL cards corresponding to the top of the flood pool for all reservoirs. Normally = 4.

**Required card

J2

2.2 * J2 CARD - Second Job Card - Operational Parameters

FIELD	VARIABLE	VALUE	DESCRIPTION
1	IFCAST	0	Twenty four hours of foresight may be used by the program to determine reservoir releases in the system operation. Value used should represent ability to forecast flows with CFLOD (J2.2) accuracy.
		+	Number of hours of foresight on inflows and local flows to be used in system operation for all reservoirs unless different values are specified on R2 cards (R2.5).
2	CFLOD	0-1	Constant is assumed = 1.0. (CKHEC5 program will give warning message).
		1+	Coefficient greater than or equal to 1 by which local flows are multiplied as a contingency allowance in the determination of upstream flood control releases. If this value is 1.2, a 20% forecasting error is assumed for IFCAST hours. A value of 1.2 is typically used for flood simulation.
3	RATCHG	0	The maximum rate of change during a one hour time period for all reservoir releases will be assumed to be .04 times the designated channel capacity (CP.2 or CC cards) unless specified differently on R2 cards for specific reservoirs.
		+	The maximum rate of change of all reservoir releases during a one hour time period expressed as a ratio of the channel capacity (CP.2 or CC cards) unless specified differently on R2 cards for specific reservoirs.

*Optional card

* J2 CARD - continued

FIELD	VARIABLE	VALUE	DESCRIPTION
4	IPRIO	0-63	A "0" is normally used.
5	IOPMD	0,1,2	A "0" is normally used.
6	ISCHED	0	Do not use scheduling (a "0" is normally used).
		1[1]	Use scheduling. No releases will be made from a reservoir unless all higher priority reservoirs in parallel are also releasing. The sum of the releases from all upstream reservoirs during any time period is not allowed to exceed damaging channel capacity at any downstream control point.
		10	For flood control operation, calculate releases assuming future releases are the same as the current periods release. This option may reduce large fluctuations in reservoir release, but may cause some error notes in not filling the downstream space as well as without this option.

*Optional card

[1]This option is used only if there is a problem in emptying an upstream reservoir which is located many times the travel time to the damage center as other reservoirs.

J3

2.3 * J3 CARD - Third Job Card - Output and Flow Options

A continuous listing of all input data card images, including flow, will be made for all jobs stacked together (up to 10,000 lines) unless a "NOLIST" in card columns 1-6 is present. A single "NOLIST" card placed in the data deck will terminate the remainder of the data card listing. A series of NOLIST and LIST cards can be used to suppress printout of data between the two cards.

Each type of output has a label on the left side of the page to make it easier to locate with an interactive text editor. The program labels are shown below.

Output Label	Output Type
*INPUT	Input data listing
*FLOWS	Formatted table of flow data
*INTAB	Summary of input data
*RTCOF	Routing coefficients from reservoirs to operating control points
*LOCFL	Computation of incremental local flows
*NORML	Normal sequential output
*ROPER	Reservoir data by period
*RRPER	Reservoir releases by period
*RQPER	Control point regulated flow by period
*USERS	User designed output (J8 and JZ cards)
*PLOTS	Plotted hydrograph
*SUMF1	Single flood summary
*EPLOT	Flood frequency plots
*HYEFF	Hydrologic efficiencies
*ERROR	Output error check
*CASES	Listing of case definitions

*Optional card

* J3 CARD - continued

FIELD	VARIABLE	VALUE	DESCRIPTION
1	PRINT	0-511	The sum of the following codes that represent the desired output (in addition to J8 card output) is used for PRINT.

Code	Option
0	All output listed below.
1	Summary of maximum events for each flood. (Single Flood Summary *SUMF1).
2	Summary of maximum and minimum values for each event and for all events. Also summary of monthly operations and system energy. (*SUMFS, *SUMPO)
4	Output error check (should always be requested). (*ERROR)
8	Normal sequential output by control point, by variable and by time period. Should only be requested for short flood events due to excessive costs. (*NORML)
16	Reservoir data by period (all floods). (*ROPER)
32	Reservoir releases and control point regulated flows and percent flood control storage used by time period (all floods). (*RRPER, *RQPER)
64	Computation of incremental local flows from natural or observed conditions. (*LOCFL)
128	Flow cards. (*FLOWS)
256	Hydrologic efficiencies (must also ask for code 2). (*HYEFF)

2	PRCOL	0-132	A "0" is normally used.
3	IPLOTJ	0-10	A "0" is normally used.
4	FLONAT	0	Natural or unregulated flows, that is, flows that would have existed if no reservoirs were upstream, will not be computed. However, they can be read on NQ cards. If ILOCAL = 20(J3.6), natural flows will be calculated and printed from the IN card data.
		-1	Natural flows will be calculated (omit NQ cards). If ILOCAL (J3.6) = 20, natural flows will be based on adjusted computed local flows (no negative locals).

*Optional card

* J3 CARD - continued

FIELD	VARIABLE	VALUE	DESCRIPTION
5	CRITPR	0	A "0" is normally used.
6	ILOCAL[1]	±1 or 0	Local flows specified on IN cards are incremental; that is, they represent local flow between adjacent control points.
		±10	Compute incremental local flows from observed gages (IN cards) and observed reservoir releases (QA cards) and STOP (do not operate system). Reservoirs used in data must correspond to reservoirs in operation during flood. Output for this computation will be printed only if code 64 is requested by Field 1 of J3 card.
		±15	Same as 10 except operate system also.
		±20	Incremental local flows are calculated from natural flows, on IN cards, and then the system is operated.
		±25	Same as 20 except do not operate the system.
7	NOROUT	0	Indicator is assumed equal to 24 hours.
		+	Indicator used to differentiate between short interval operation that would use routing and forecasting IFCAST (J2.1 or R2.5) and long interval conservation operation in which routing and forecasting would not be used. Channel routing and forecasting will not be made if IPER (BF.7) is greater than NOROUT.
8	INFLOW	0	Input flow data is average for the period.
		1	Input flow data is end-of-period on IN and NQ cards. QA cards are always average values. Program will average flow data.
9-10			Not used.

*Optional card

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[1]A negative value for ILOCAL will in addition allow the use of and/or the computation of negative local flows. A positive value zeros out all negative flows. Flow volumes will be redistributed within the hydrograph if local flows are calculated (codes ±10 thru ±25). For ILOCAL codes which do not provide for system operation (±10 and ±25), data cannot be written to a DSS file (JZ and ZW cards) and the HEC5B program should not be executed.

2.4 * J8 CARD - User Determined Output Format (0-20 cards)

Optional card used by the HEC5B part of the program to format user-defined output. Each card used will specify output variables to be printed for up to 10 columns.

1-Data by Period (first field is positive) CP.VAR

Each field of the card used should contain the control point location (to the left of the decimal) and variable code (to the right of the decimal). For example, a 10.10, 15.10, 10.12, 15.12, 10.13, 15.13 in fields 1-6 would print six vertical columns for each period of the routing showing in order: the outflows for reservoirs 10 and 15 (code 10 = outflow), cases (code = 12) for reservoirs 10 and 15, and levels (code = 13) for reservoirs 10 and 15. Add .009 if output should be converted from cfs to acre feet.

Variable codes to be used are:

X.00	Provides computed difference between the previous two tabulated variables using location X as title, X cannot be = 0.	.14	Reservoir Eq. Level[1]
		.17	Channel Capacity
		.18	Q Space
.01	Cumulative Local Flow	.19	U.S. Res/Div Floww
.02	Natural Flow	.20	Flooding GT Local Q
.03	Diversion	.22	Elevation EOP
.04	Regulated Flow (nonreservoir)	.24	Incremental Local Flow
.09	Reservoir Inflow	.30	Diversion Requirements
.10	Reservoir Outflow	.31	Diversion Shortages
.11	Reservoir EOP Storage	.36	Gate Regulation Release
.12	Reservoir Case	.37	Percent of Flood Control Storage
.13	Reservoir EOP Level	.38	Top of Conservation Storage

-1 Field 10 of first J8 card only; allows the HEC5B to read additional J8 cards for post processing with a saved "TAPE18" (output from the HEC5A part of the program).

*Optional card

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[1] For downstream tandem reservoirs only.

JZ

2.5 * JZ CARD - User Defined Output Variables for HEC-DSS (maximum of 20 J8 and/or JZ cards)

Optional card, used in conjunction with the ZW card, to designate output variables to be stored on an HEC-DSS file. These cards are used similar to the "Data by Period" type of J8 cards. The data is both written to DSS and printed (like J8 cards) unless the value for the first field of the first JZ card is made negative, in which case it is only written to DSS.

If a JZ card is omitted and a ZW card is used, the default codes for regulated flow (0.04) at all non reservoir control points plus the inflow (.09), outflow (.10) and EOP storage (.11) for all reservoirs will be written to the HEC-DSS file.

Variable Code	"C part"	Data Units	Data Type
.01	FLOW-LOC CUM	CFS	PER-AVER
.02	FLOW-NAT	CFS	PER-AVER
.03	FLOW-DIV	CFS	PER-AVER
.04	FLOW-REG	CFS	PER-AVER
.09	FLOW-RES IN	CFS	PER-AVER
.10	FLOW-RES OUT	CFS	PER-AVER
.11	STOR-RES EOP	ACFT	INST-VAL
.12	CASE-RES		PER-AVER
.13	LEVEL-RES		INST-VAL
.14	LEVEL-RES EQ		INST-VAL
.17	FLOW-CHAN CAP	CFS	PER-AVER
.18	FLOW-Q SPACE	CFS	PER-AVER
.19	FLOW-US RES	CFS	PER-AVER
.20	FLOW-FLOOD RES	CFS	PER-AVER
.22	ELEV	FEET	INST-VAL
.24	FLOW-LOC INC	CFS	PER-AVER
.30	FLOW-DIV REQ	CFS	PER-AVER
.31	FLOW-DIV SHRT	CFS	PER-AVER
.36	FLOW-GATE REG	CFS	PER-AVER
.37	PERCENT F.C.STOR	PERCENT	INST-VAL
.38	TOP CON. STORAGE	ACFT	INST-VAL

*Optional card

3 CARDS FOR ALL RESERVOIRS (Cards RL - RG)

All Reservoirs - Cards RL, RO, RS, and RQ are required for all reservoirs. Omit for nonreservoirs. The most upstream control point on each tributary must be a reservoir.[1]

3.1 ** RL CARD - Reservoir Target Levels[2]

FIELD	VARIABLE	VALUE	DESCRIPTION
1	MM	+	User integer identification number for the control point. The computer will generate another subscript M for internal identification (computer I.D. number), which is shown in trace output and in input summary.
2	STOR1	+	Initial storage of reservoir MM in acre-feet or 1000 cubic meters.
3-17	STORL(M,L)	+	Cumulative reservoir capacities for control point MM in acre-feet or 1000 cubic meters for each of NULEV levels (J1.3) starting with reservoir storage allocation level 1. If NULEV (J1.3) exceeds 8, two RL cards per reservoir are required. Level LEVBUF(J1.6) is the top of buffer pool. Level LEVCON(J1.4) is the top of conservation pool. Level LEVTFC(J1.5) is the top of flood control pool. For routing intervals less than monthly (or less than the length of the season described on the optional CS card), input capacities represent conditions for cumulative days specified on CS card or at end of month (if no CS card). Interpolations between monthly (seasonal) storages are made for each time period.

**Required card for reservoirs

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[1]Cards RL-CG are repeated in turn for each control point (reservoir or information point) in downstream order until all control points have been specified. No downstream locations may be specified until all locations which route to that location are specified. The maximum number of control points (reservoir and non-reservoir) as well as the maximum number of reservoirs depends on the computer used and is shown at the beginning of each HEC-5 printout. If a control point is not a reservoir, cards RL-RG are omitted, and only control point cards CP-CG are used. All control points above each confluence must be specified before the confluence control point. Last control point cannot be a reservoir. If your system has two or more tandem reservoirs, read the HEC document on early inflow calculation.

[2]All reservoirs in the system are balanced using these target levels (see Exhibit 3 of the HEC-5 Users Manual).

3.2 * ADDITIONAL RL CARDS

Additional RL cards can be used when reservoir storage allocation levels change during the year. These cards will be read after the first RL card(s) (storage data will be ignored on the first RL card(s) if additional RL cards are used). NULEV(J1.3) groups (one or two cards each) of additional RL cards will be read in increasing order of level.

FIELD	VARIABLE	VALUE	DESCRIPTION
1	L	+	Reservoir level number (1-15).
2	MM	0	A "0" is normally used.
3	IRPT	0	Storages will be read for all 12 months. Two RL cards are required for this level.
		-1	Storage in Field 5 will be used for all months. Only one RL card for this level will be used.
		+	Number of storages (not to exceed 11) to be read for Level L. Corresponds to the seasons described by cumulative days (in the calendar year). Seasons are specified on CS cards.
4	FACTR	0	All storages are read in acre-feet or thousands of cubic meters.
		+	Storage on Fields 5-10 will be multiplied by FACTR.
5-10	STORL (M, L, K)	+	Reservoir storage for each month for level L. The first six values of storage appear on the first card in Fields 5-10, and the remaining six values (if used) must be in Fields 5-10 of the second card (Fields 1-4 are omitted). The first monthly value must correspond to the variable ISTMO(J1.2) (usually January or October). More than one acre-foot of flood control storage should be shown for the first month if downstream CUMULATIVE LOCAL FLOW should not include local flows above this reservoir.

*Optional card

3.3 ** RO CARD - Reservoir Operation Points[1]

Rules for RO Card

1. All reservoirs with flood control storage and with gated flood control outlets, which are above (no reservoirs in between) one or more flood control points (which have a non-fictitious channel capacity) must be operated for each of the control points.

2. Reservoirs with flood control storage and flood control outlets may also operate for downstream reservoirs with flood control storage, but the upstream reservoirs must not operate for downstream flood control locations which are themselves downstream of other reservoirs with flood control storage. Thus an upstream flood control reservoir cannot be specified on the RO card to operate through another reservoir (with flood control storage) for a downstream location for flood control. Tandem flood control reservoir systems (upstream reservoir operates for downstream reservoir) accomplish this goal by a system operation.

FIELD	VARIABLE	VALUE	DESCRIPTION
1	NSERV	+	Number of downstream control points for which reservoir MM is operated to prevent flooding or to provide low flows. If MM has flood control storage and a gated flood control outlet, this value should be equal to one or more. Up to 18 control points may be used; however, each additional point increases computer time.
2+	ISERV(M,K)	+	Control point numbers for which reservoir MM is operated. NSERV values in any order. If reservoir MM is specified to be operated for the next downstream reservoir, MM will operate to balance levels in both reservoirs. In general, MM should not operate for control points below the next downstream reservoir. If flood routing is used (see RT card), then all gated upstream reservoirs with flood control storage which are operated in parallel must operate for all downstream locations which are subject to flooding.

**Required card for reservoirs

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[1]Downstream locations (ISERV(M,K)), which are operated for by Reservoir M, are operated for time periods IFIRST to LOOK. IFIRST is the first time period where the current release would have a one percent or more effect. LOOK is the last time period within the allowable forecast period (J2.1 or R2.5). Where IFIRST for downstream operating locations is greater than LOOK, IFIRST is set equal to LOOK. Thus, reservoir releases will be curtailed if a downstream operation point is flooding at the maximum forecast period (LOOK) even though the reservoir release may not reach the downstream location during the forecast period. The controlling location in the program output, under CASE, is for the most downstream location that is flooding.

RS

RQ

3.4 ** RS CARD - Reservoir Storage Capacities

FIELD	VARIABLE	VALUE	DESCRIPTION
1	NK	+	Number of values of STOR(M,K) and QCAP(M,K). (Must be at least 2.)
		-	Number of values of STOR as above (negative). Also values of STOR(M,K) are in 1000's of units on input cards and will be multiplied by 1000 by the program.
2+	STOR(M,K)	+	Reservoir capacity in acre-feet or 1000 cubic meters for control point MM corresponding to RQ card values. NK values. Dimension limit for K, for cards RS, RQ, RA, RE, and RD is KNCAPT (currently = 18). First or second storage value should be the inactive storage value, and two successive values should not be equal. If more than 9 values are given, start in first field of second RS card with tenth storage value.

3.5 ** RQ CARD - Reservoir Outlet Capacities

FIELD	VARIABLE	VALUE	DESCRIPTION
1	NK	+	Number of values of QCAP(M,K) on this card and STOR (M,K) on RS card.
2+	QCAP(M,K)	+	Total reservoir outlet capacity for control point MM in cfs or cubic meters per second. NK values. First value should be equal to or greater than the minimum outflow desired.
		-1	Unlimited outlet capacity at STOR(M,K). This option sets the outflow equal to the inflow when reservoir reaches the value of STOR that corresponds to a negative QCAP. This option should be used for all dummy reservoirs to eliminate adding fictitious release rates.

**Required card for reservoirs

3.6 ** RE CARD - Reservoir Elevations

FIELD	VARIABLE	VALUE	DESCRIPTION
1	NK	+	Number of values of EL(M,K) on this card and STOR(M,K) on RS card.
2+	EL(M,K)	+	Reservoir elevations for control point MM corresponding to RS card storages. NK values.

3.7 * RD CARD - Reservoir Diversions or Minimum Releases

FIELD	VARIABLE	VALUE	DESCRIPTION
1	DVEXC	0,+	All diversions are made based on reservoir storage (RS card).
		-1	Diversions are equal to the excess flood waters above the top of conservation up to the outlet capacity of the diversion pipe (FDQ). The second value on this card must be greater than 0.0.
		-10	Minimum reservoir releases are shown for FDQ values as functions of reservoir storages (RS card). Induced surcharge envelope curve values (minimum reservoir releases during emergency conditions) can be shown on RD and RS cards, and maximum reservoir releases vs. reservoir storages on RQ and RS cards. For this option only, do not use DR cards since reservoir releases determined from this option will not appear as diversions. (Applies to rising limb of hydrograph only.)
2+	FDQ(M,K)	+	Diversion discharges from reservoir MM corresponding to values of STOR(M,K) on RS card. If Field 1 is -1, Field 2 must be greater than zero (use .01 or greater). NK (RS.1) values.

**Required card for all reservoirs using gate regulation option (RG data)
* Optional card

R2

3.8 * R2 CARD - Additional Reservoir Data

FIELD	VARIABLE	VALUE	DESCRIPTION
1	RTCHGR	0	The rate of change on Field 3 of the J2 card (or a default value of .04 per hour) will be used for this reservoir (RL.1).
		+	The allowable rate of change of reservoir releases, during a one-hour time period, when the release from this reservoir increases from the previous period. If RTCHGR is greater than 2: In cubic feet per second (cfs) or cubic meters per second (m^3/sec) per hour. If RTCHGR is less than 2: Expressed as a ratio to the channel capacity at this reservoir (CP.2 or CC card) during a one hour time period.
2	RTCHGF	0	The rate of change on Field 3 of the J2 card (or a default value of .04 per hour) will be used for this reservoir (RL.1).
		+	The allowable rate of change of reservoir releases, during a one-hour time period, when the release from this reservoir decreases from the previous period. If RTCHGF is greater than 2: In cfs (or m^3/sec) per hour. If RTCHGF is less than 2: As a ratio (per hour) to the channel capacity at this reservoir (CP.2 or CC card) during a one-hour time period.
3	EVRTO	0, +	A "0" is normally used.
4	RELSTR	0, +	A "0" is normally used.

*Optional card

* R2 CARD - continued

FIELD	VARIABLE	VALUE	DESCRIPTION
5	IFCST(M)	0	The foresight shown on J2 card (Field 1) for inflows and local flows will be used for reservoir MM when short interval routings are made, i.e., when IPER (BF.7) is less than or equal to NOROUT (J3.7).
		+	IFCST(M) hours of foresight for inflows and local flows will be used for reservoir MM when IPER is less than or equal to NOROUT.
6	HPOINF(M)	0	No hinged pool operation.
		+	Inflow magnitude above which the reservoir top of conservation storage will be reduced from RL data to HPOSTG(M). This hinged pool operation is sometimes used on navigation locks.
7	HPOSTG(M)	0	No hinged pool operation.
		+	Storage at top of conservation pool when inflow is at or above HPOINF(M).
8-10			Not used.

*Optional card

3.9 * RG CARD - Gate Regulation Curve[1,2]

FIELD	VARIABLE	VALUE	DESCRIPTION
1	ELTSUR(M)	+	Elevation in feet or meters of top of induced surcharge (usually 1-5 feet above top of flood control pool). If this elevation does not exceed Field 2, the program will assume .1 foot higher than Field 2.
2	ELSURO(M)	+	Elevation in feet or meters of bottom of induced surcharge (usually equal to top of flood control pool).
3	QSURO(M)	0, +	Discharge in cfs or m^3/sec on induced surcharge envelope curve at elevation "ELSURO" (should be equal to channel capacity or less).
4	TSCON(M)	+	Constant representing recession of hydrographs in hours (see EM 1110-2-3600). Can be equal to zero if ITYSP is zero.
5	SPWID(M)	+	Width (in feet or meters) of spillway excluding piers (used in calculating approximate gate opening).
6	ELSPI(M)	+	Elevation (in feet or meters) of spillway crest.
7	QMIN1(M)	0, +	For uncontrolled spillways only (ITYSP=0). Minimum conduit release (in cfs or m^3/sec) on rising limb of hydrograph when elevation is below ELSPI.
8	CQELSP(M)	0, +	Conduit discharge (in cfs or m^3/sec) at spillway crest.
9	ITYSP(M)	0	Uncontrolled spillway.
		10	Gated spillway. Inflow used for gate regulation calculation will be based on average inflow for previous 1 hour.
		12	Same as 10, except inflow based on previous 2 hours.
		13	Same as 10, except inflow based on previous 3 hours.

*Optional card

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[1]A default induced surcharge envelope curve will be assumed if not given on RD card (-10 for first field).

[2]When RG card is used the RE cards are also required. When the RG card is used the pre-release option should not be used (J2.5 should = 0).

* RG CARD - continued

FIELD	VARIABLE	VALUE	DESCRIPTION
10	TYPFAL[1]	0	Use average of previous outflow and current inflow (HEC-5 output case=.22) when reservoir falls below top of flood pool and release greater than channel capacity is needed.
		+X.Y	Elevation and type of operating criteria to use when reservoir is falling and is below top of flood pool. Integer part of TYPFAL (X) represents reservoir elevation below which emergency releases will not be made. The decimal part (Y) of TYPFAL represents a code depicting the type of operation to be used as follows: Y = .0 Use average of previous outflow and inflow (HEC-5 output case=.22). Y = .1 Use outflow = inflow (HEC-5 output case =.23).

*Optional card

[1]For this option, these emergency releases will be made even when flooding is occurring at a downstream location.

4 CONTROL POINT CARDS FOR HYDROLOGIC DATA (Cards CP - CG)

Cards CP, ID, and RT are required for all control points including reservoirs.

4.1 ** CP CARD - Control Point Card

FIELD	VARIABLE	VALUE	DESCRIPTION
1	MM	+	User integer identification number. Must be equal to MM of the RL card if this control point is a reservoir.
2	QMX(M)	+	Maximum flow (nondamaging capacity) in cfs or m^3/sec desired at control point MM. Must be greater than 1.0.
		-	Stage (in feet or meters) for location MM at which upstream reservoirs operating for location MM will make minimum releases. Stage hydrographs for location MM are read on EL cards with other time series data such as inflows (IN cards).
3	QMINL(M)	0, +	A "0" is normally used.
4	QMINR(M)	0, +, -	A "0" is normally used.
5	QMDRAT	0	A "0" is normally used.
6	CFLD(M)	0	Factor CFLOD(J2.2) will be used for contingency factor.
		+	Contingency factor (equal to one or more) for forecasting cumulative local flows at control point MM.

**Required card

4.2 ** ID CARD - Identification Card for Control Point

FIELD	VARIABLE	VALUE	DESCRIPTION
1-4	CPT(M,1-10)	any	Title (alphanumeric) of control point in columns 3-32. Columns 3-32 will be printed in summary output.
5-10			Not used.

NOTE: When using HEC-DSS the following will apply (see also Section 6):

1-2	NAMCPO	any	The control point name which is the B part of the pathname to be used with the ZW card data in order to identify any output data which may be stored on HEC-DSS.
3-4	NAMCPI	"blank"	If this field is blank, the output name for HEC-DSS (NAMCPO) will be used for the input name (NAMCPI).
		any	The control point name used with the ZR card to identify the input data which will be read from HEC-DSS.
5-10			Not used.

**Required card

C1

4.3 * C1 CARD - Additional Control Point Data Card

FIELD	VARIABLE	VALUE	DESCRIPTION
1	LQCP(M)	0	Flows for MM are read from card IN.
		+	IN cards do not have to be read for control point MM; instead, flows for MM can be based on values on card IN for the same or another control point LQCP(M) in the system. Flows for MM are equal to factor RTLQ(M) multiplied times the flows on the IN cards for location LQCP(M) and lagged by QLAG(M).
2	RTLQ(M)	0	Flows for MM are read as card IN for location MM.
		+	Ratio which is multiplied by flows at LQCP(M) to obtain flows at location MM.
3	QLAG(M)	0	No lag.
		+ or -	Number of periods local flows are to be lagged forward in time (+) or backward (-) expressed in IPER (BF.7) units.

*Optional card

4.4 ** RT CARD - Routing card

FIELD	VARIABLE	VALUE	DESCRIPTION
1	RTFR(M)	+	Control point number of upstream end of routing reach. Equal to MM on the CP card.
2	RTTO(M)	+	Control point numer of downstream end of routing reach MM. Equal to MM of the CP card for the next downstream control point. May be left blank for last control point in system (last point must be a nonreservoir).
3	RTMD(M)	0	No routing. Fields 4 and 5 are ignored.
		+X.Y	Number of subreaches (X), maximum of twelve, (to left of decimal) and codes (Y) for method of routing for reach MM Y = 1 for Straddle-Stagger and Tatum, Y = 2 for Muskingum, Y = 3 for Modified Puls, Y = 4 for Working R&D Y = 5 for Modified Puls as a function of inflow Y = 9 for reading routing coefficients on CR card (not needed in input) A 3.2 indicates three subreaches will be used in the Muskingum method. (Methods 3, 4 and 5 require QS and SQ cards.)
4	X[1]	+	Muskingum routing coefficient "X" for each subreach of reach MM. For the Muskingum and Working R&D methods, use the desired value of X between 0 and .5. Use 0 for Modified Puls. Enter the number of ordinates to be straddled and staggered (such as 3.1 for 3/1 Straddle-Stagger). For routing by the Tatum (successive Average-Lag) method, enter a 2.1 and make RTMD(RT.3) equal to the integer value of 2K/IPER + .1.
5	K	0	For Modified Puls, R&D, and Straddle-Stagger.
		+	Travel time (Muskingum K) in hours for Muskingum subreach. To avoid negative coefficients, K, for the subreach, should be approximately = IPER (BF.7); in no case should K be less than IPER/[2•(1-X)] or greater than IPER/2X.

**Required card

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[1]Do not use routing criteria that specifies that outflows are a function of future period inflows (e.g., Straddle-Stagger of 3/0). The 3/0 Straddle-Stagger would have outflow for the present period equal to 1/3 the inflow for the previous, present, and future periods.

** RT CARD - continued

FIELD	VARIABLE	VALUE	DESCRIPTION
6	LAG	0	No lag in addition to routing.
		+	In addition to routing specified by Methods 1-5, lag outflow by the number of periods shown in this field.
7	RTPER(M,I)	0	First RT card criteria for this control point (MM) will be used whenever flood routing is done.
		+	Time interval applicable to this RT card. A second RT card can be used to describe a second set of RT data (second RT card is limited to linear routing method; i.e., Modified Puls and R&D are not allowed). The second RT card criteria will be used only if IPER (BF.7) is equal to RTPER; otherwise the first RT card criteria will be used.
8	RTMNAT(M)	0	The routing criteria specified on this card will be used for all flow types (natural, regulated, etc.).
		1	The routing criteria specified on this card will be used only for natural flow calculations. No routing will be performed for other types of flows. This option allows the inflows specified at headwaters of a reservoir (specified as a dummy reservoir) to be routed through the reach, which is now occupied by water in the reservoir.
9-10			Not used.

4.5 * CR CARD

FIELD	VARIABLE	VALUE	DESCRIPTION
1	NUMCOF(M)	+	Number of routing coefficients on this card(s); may not exceed dimension limit for KRTCOF (presently=11).
2+	TRTCOF(M,K)	+	Routing coefficients (as coefficients of inflow - see equation 2 of Exhibit 2 in HEC-5 Users Manual) to be used in this reach (see RT card). These coefficients will override coefficients generated by the RT card. Sum should be equal to 1.0.

**Required card
* Optional card

4.6 * DR CARD - Diversion Data for Control Point

For diversion requirements to be satisfied by upstream reservoirs, RO cards must specify that one or more reservoirs will operate for the diversion location. Dimension limit for number of diversions is KDIV (currently = 11).

FIELD	VARIABLE	VALUE	DESCRIPTION
1	DRTFR(NDIV)	+	Control point identification number (same as MM on CP card) where diversion is made.
2	DRTTO(NDIV)	0, +	Control point number where diversion returns to system. Diversion flows will be routed from MM to DRTTO(NDIV). Can be zero if there is no return flow.
3	DRTMD(NDIV)	+	Routing method for diversion. See RTMD of RT card (Field 3). Only linear methods are allowed.
4	DRTCOF(NDIV)	+	Routing coefficient "X" for diversion. See RT card (Field 4).
5	DMUSK(NDIV)	+	Routing coefficient "K" for diversion. See RT card (Field 5).
6	DCON(NDIV)	0	100% of diversion flow is returned.
		+	Percentage of flow (expressed as a ratio) diverted at MM which returns at DRTTO(NDIV). A .2 indicates 20% of diversion returns.
7	KDTY(NDIV)	0	Diversion flow is constant and equal to DFLOW(NDIV) on 8th field (QD card not needed).
		1	For monthly operations, 12 flow values on the QD card would provide monthly diversions that would cycle through for each year's operation.
		-1[1]	Diversion quantity is a function of the inflows at control point MM according to the tables of CHQ (QS card) and FDQ (QD card).

KDTY codes -2, -4 and -5 are described on the next page.

*Optional card

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[1]Since these diversion types (DR.7, KDTY = -1 or -4) are not based upon fixed schedules, but are functions of flows or levels which are dependent upon upstream reservoir releases, simulations of complex systems which employ these diversions should be carefully reviewed to ascertain if the desired precision of operation is achieved.

* DR CARD - continued

FIELD	VARIABLE	VALUE	DESCRIPTION
			KDTY codes 0, 1, and -1 are described on the previous page.
		-2	Diversion quantity is a function of the reservoir storage for MM according to the tables of STOR (RS card) and FDQ (RD card).
		-4[1]	Diversion quantities on the QD card specify monthly diversion expected to arrive at the upstream location from a downstream (later in card sequence) location. This could represent a pumping condition. This option is similar to the pumped storage option (see Complete March 1985 Exhibit 8, KDTY = -3 and Exhibit 5) in that negative diversions are specified at the upstream location (this control point) which diverts to the downstream location. If the upstream location is a reservoir, the diversions are limited by the top of conservation pool or level LEVPUM (see Complete March 1985 Exhibit 8, J1.7). If the downstream location is a reservoir, the diversions are limited by the top of buffer pool (or Level 1 if diversion priority IPRIO = 4 (J2.4)). If the downstream location is not a reservoir, the diversions are limited by the local inflow. For this option, a dummy reservoir is not required above the upstream diversion reservoir as is the case for pumped storage.
		-5	Diversions vary by period and are based on on the QD cards which appear in the time series data (after the BF card).
8	DFLOW(NDIV)	0	Diversion flow is not constant.
		+	Diversion flow is constant and equal to DFLOW. Field 7 must be = 0.
9	DIVRAT	0	Ratio used is 1.0.
		+,-	Ratio which is multiplied times the diversion flows (RD, DR.7, QD cards).
10			Not used.

*Optional card

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[1]Since these diversion types (DR.7, KDTY = -1 or -4) are not based upon fixed schedules, but are functions of flows or levels which are dependent upon upstream reservoir releases, simulations of complex systems which employ these diversions should be carefully reviewed to ascertain if the desired precision of operation is achieved.

4.7 * QS CARD - River Discharges for Diversions, Variable Channel Capacity or Routing Options

QS cards are used with DR and QD cards to specify diversions which vary with flow in channel (diversion type -1); with CC cards for specification of variable channel capacities (Channel capacity option 3); and with RT and SQ cards for specification of Modified Puls routing data (routing methods .3 and .5).

For Modified Puls routing which varies as a function of inflow (RT.3 = .5) multiple sets of QS and SQ cards are provided for up to six sets of storage and outflow data which are each a function of a given index inflow. For this method the maximum number of outflow values = 9. Also the storage outlfow (QS-SQ) sets must be input in increasing magnitude of inflow and the first index inflow should be zero. The zero inflow set would be equivalent to the basic Modified Puls (RT.3=.3) which does not consider inflow.

FIELD	VARIABLE	VALUE	DESCRIPTION
1	NPTSQ	2-18	Number of river discharges on QS card. For use with diversion and variable channel capacity options (RT.3 = .3).
		0,+	Index inflow for Modified Puls routing method .5. Maximum number of CHQ(M,N) is nine.
2-19	CHQ(M,N)	+	A table of river outflows in cfs or m^3/sec at the downstream end of reach MM. Outflows correspond to the storages given on the SQ cards for use in non-linear flood routing from control point MM. NPTSQ values. Each value should be unique ($\Delta S/\Delta Q$)*12.1 must be greater than 0.5* (BF.7) for each interval.

4.8 * SQ CARD - Channel Storages

FIELD	VARIABLE	VALUE	DESCRIPTION
1	NPTSQ	+	Number of values on QS and SQ cards.
2-19	CHSTG(M,N)	+	A table of channel storages in acre-feet or 1000 cubic meters. Storages correspond to the outflows given on the QS cards. Storage represents total volume between control point MM and control point RTTO(M). NPTSQ values.

*Optional card

QD

EL

4.9 * QD CARD - Diversion Flows for Diversion Types 1, -1, and -4

FIELD	VARIABLE	VALUE	DESCRIPTION
1	NUMDQ	+	Number of DQ(I,M) values on QD cards for this control point. Maximum number = 18.
2-19	FDQ(M,N)	+	When KDTY (Field 7) of DR card = -1, Fields 2-10+ (up to 19) are the diversion flows corresponding to values of channel flow, CHQ(M,N), on the QS card.
	OR		
2-19	FDQ(M,N)	+, -[1]	When KDTY (Field 7) of DR card = -4 or 1, FDQ represents the monthly diversion flows in cfs or m^3/sec. Twelve monthly values are given. The first value must correspond to the variable ISTMO (J1.2).

4.10 * EL CARD - Elevation or Stage for Damage Center at MM (non-reservoir)

FIELD	VARIABLE	VALUE	DESCRIPTION
1	NPTSQ	+	Number of outflows on QS card.
2-19	EL(M,N)	+	Elevation or stage in feet (or meters).

*Optional card

[1]Negative values may be used if upstream location is a reservoir and KDTY (DR.7) = -4 (pumping). Otherwise, negative diversions are not changed when sufficient flows are not available at downstream location (could result in negative downstream flows).

4.11 * CL CARD - Reservoir Levels for Variable Channel Capacities

Optional card for specifying the reservoir levels corresponding to the channel capacity at location MM (CP.1). These reservoir levels correspond to location ILOCCC on the following CC card, Field 1.

FIELD	VARIABLE	VALUE	DESCRIPTION
1	NLEVS	+	Number of reservoir levels on this card. A maximum of 18 values.
2-19	RLEVCC(M,K)	+	Reservoir levels corresponding to channel capacities on the next CC card. NLEVS values in increasing order.

*Optional card

CC

4.12 * CC CARD - Channel Capacity for Control Point

Optional card for varying the operational channel capacity at this location, CP.1, (either a reservoir or a control point). The channel capacity can vary monthly or by seasons or with the flow at any location; or it may be based on reservoir levels; or it may be based on seasonal guide curves; or be based on seasonal total system flood control storage. Maximum of two cards per location. When this card is omitted, QMX (card CP.2) is used for the channel capacity.

OPERATIONAL CHANNEL CAPACITY OPTIONS

OPTION	DESCRIPTION	CARDS REQUIRED
1	Channel capacity is based on month.	CC
2	Channel capacity is based on season	CC,CS
3	Channel capacity at this location is based on flow at another specified location.	CC,QS
4	Channel capacity at this location is based on reservoir level at specified reservoir.	CC,CL
5	Channel capacity at this location is a function of both season (time of year) and level (or elevation) at specified reservoir.	CC,CS,CG
6	Channel capacity at this location is a function of both season and percent of total system flood control storage.	CC,CS,GS,CG

NOTE: CC cards can also be used in time series data to input period by period varying channel capacities.

*Optional card

* CC CARD - Continued

FIELD	VARIABLE	VALUE	DESCRIPTION
1	ILOCCC(MM) .OPTION	0.1	OPTION 1: Channel capacities are based on the months of the year. The number of channel capacities read is equal to 12 (two CC cards). The first channel capacity (Field 2) must correspond to the starting month ISTMO(J1.2).
		0.2	OPTION 2: Channel capacities are based on season of year (up to 18 seasons) using the CS card to define the ending day of each season. Interpolations will be made for each time period of the routing.
		X.3	OPTION 3: Identification number (X) of control point used to obtain inflows that are compared with flows (read on the QS cards) for this location. Channel capacities corresponding to QS flows, start in Field 2.
		X.4	OPTION 4: Identification number (X) of reservoir (RL.1) whose level is used to compute the channel capacity based on CL card data.
		X.5	OPTION 5: Identification number (X) of reservoir (RL.1) whose level (or elevation), from CG card, and season (CS card) will be used to compute the channel capacity.
		X.6	OPTION 6: Channel capacity at this location is a function of both season (CS card) and total system flood control storage (CG card) for location X. Also, see GS card.

*Optional card

* CC CARD - Continued

FIELD	VARIABLE	VALUE	DESCRIPTION
2-13	CHCAPT(K)	+	OPTION 1: Twelve monthly channel capacities are specified, starting with the month specified as ISTMO(J1.2).
or 2-19	CHCAPT(K)	+	OPTION 2: Up to 18 channel capacities are specified, corresponding to the seasons shown on the CS card.
or 2-19	CHCAPT(K)	+	OPTION 3: Channel capacities on this card(s) correspond to inflows at location ILOCCC(MM) based on the QS card flow values for this location. Interpolated values of the channel capacity will be used as the flood hydrograph progresses, except that the channel capacity is never decreased as long as the regulated flow exceeds the channel capacity. Thus, once the maximum channel capacity is reached, it is maintained as long as the regulated flood hydrograph exceeds the channel capacity. Number of channel capacities read is NPSTQ (QS.1). Maximum of 18.
or 2-19	CHCAPT(K)	+	OPTION 4: Channel capacities on this card(s) correspond to the reservoir levels on the CL card for location ILOCCC(MM). Interpolations are made for channel capacities between values on these cards. NLEVS (CL.1) values. Maximum of 18.
or 2-9	CHCAPT(K)	+	OPTIONS 5: Channel capacities on this card (in increasing order) correspond to the reservoir levels or elevations (in increasing order) on the CG cards for location ILOCCC(MM) and seasons on the CS card. A maximum of 8 channel capacities may be used.
or 2-9	CHCAPT(K)	+	OPTION 6: Channel capacities on this card (in increasing order) corresponding to the percent of flood control storage in the reservoir system based on the CG card for location ILOCCC(MM) and seasons on the CS card. A maximum of 8 channel capacities may be used.

*Optional card

4.13 * CS CARD - Seasons for Variable Channel Capacities or Reservoir Levels

FIELD	VARIABLE	VALUE	DESCRIPTION
1	NSEA	+	Number of seasons to be read on this card as well as on each CG card and/or RL card. A maximum of 11 seasons can be used in conjunction with RL cards, and a maximum of 18 is permitted for use with the CG card.
2-19	CGSEA(MX,IS)	+	Cumulative number of days from the beginning of the calendar year for each season (IS) that will correspond to each value specified on CG cards and/or RL cards for location MX. The last value must be = 365.

*Optional card

4.14 * GS CARD - System Flood Control Guide Curve Specification Card[1]

Optional card used with CC card channel capacity (Option 6) for location MM (CP.1) to specify certain parameters concerning the guide curve (CG cards) for a flood control system. Only one GS card can be used in the basin and MM must be at a nonreservoir location that is downstream from flood control projects which are to be used in calculating the percent of flood control storage in the system. Parameter used on the CG card is percent flood control storage, instead of elevation or reservoir level.

FIELD	VARIABLE	VALUE	DESCRIPTION
1	GCFCST	0	IFCAST (J2.1) hours will be used.
		+	Number of hours into the future when the percent of flood control storage will be calculated.
2	GCSYFC	0	The system flood control storage will be based on summing the flood control storage in all reservoirs that are located above MM.
		+	The system flood control storage in acre-feet (or 1000's cubic meters), which is used to calculate the percent of system flood control storage. Used as a parameter with the CG card data for location MM (percent is used instead of level or elevation).
3	GCSYSQ	0	Reservoir release for system evacuation for future periods (GCFCST) will be based on the sum of the channel capacities for all reservoirs that release directly (not through other reservoirs) to location MM.
		+	Sum of reservoir releases (in cfs or m^3/sec) representing the expected system releases during the forecasted period (GCFCST).

*Optional card

[1] GS card follows the CS card and proceeds the CG cards. These cards plus CC card (Option 6) are required if a GS card is used.

4.15 * CG CARD - Seasonal Guide Curve for Channel Capacities Using Options 5 and 6

A CG card is required for each channel capacity specified on the CC card in order to specify the guide curve for that capacity. If more than 9 seasons are specified on the CS cards, two CG cards are required for each channel capacity. The CG cards are arranged in the same order as the channel capacities on the CC card.

FIELD	VARIABLE	VALUE	DESCRIPTION
1	CGVAR (IS,IC,MX)	±X.Y	Code X (to left of decimal point) and channel capacity reference number Y for the channel capacity (IC) corresponding to the reservoir (MX) data on this CG card (to right of decimal point). Reservoir levels are used on this card starting in Field 2 unless Field 1 is negative, and then elevations are used. The channel capacity reference number Y is for the user's reference only and is not used by the program. A suitable reference number might be the channel capacity expressed as a decimal (e.g., divided by 1000 or 10000), or perhaps the CC card field number in which the channel capacity is specified. The code X to the left of the decimal is used to select the method by which channel capacity is to be interpolated within reservoir zones. The parameter is percent flood control storage if GS card is used for this location instead of elevation or level. The codes are as follows:

Code	Method of Determination
X = 0	Channel capacity for a reservoir level (or elevation) within a zone is the capacity associated with the level (or elevation) specified for the top of the zone.
X = 1	Channel capacity for a reservoir level (or elevation) within a zone is the capacity associated with the level (or elevation) specified for the bottom of the zone.
X = 2	Channel capacity for a reservoir level (or elevation) within a zone is obtained by linear interpolation between the levels (or elevations) specified for the top and bottom of the zones.

CGVAR (IS,IC,MX) codes 3 and XX are described on the following page.

*Optional card

* GS CARD - continued

FIELD	VARIABLE	VALUE	DESCRIPTION
4	GCSYMT	0	Equation 2 will be used.
		1 or 2	Equation number for calculating the percent of system flood control storage above location MM at time GCFCST into the future. Equations are as follows:

EQ1 = (100./GCSYFC) * (SUMS+SUMIO)

EQ2 = (100./GCSYFC) * (SUMS+SUMIOA)

where:

SUMS = sum of flood control storage used for current time period (no negatives) in all upstream reservoirs above MM.

SUMIO = sum of inflows less sum of reservoir releases expected in next GCFCST hours converted to acre feet (or cubic meters).

SUMIOA = sum of inflows less GCSYSQ releases in next GCFCST hours converted to acre feet (or cubic meters).

*Optional card

* CG CARD - continued

FIELD	VARIABLE	VALUE	DESCRIPTION
			CGVAR(IS,IC,MX) codes 0 - 2 are described on the previous page.
			X = 3 Channel capacity for a reservoir level (or elevation) within a zone is the arithmetic average of values specified for the top and bottom of the zone.
			X = XX Channel capacity is equal to the maximum discharge that has occurred at the location specified in Field 1 of the CC card during the last XX time intervals. However, the channel capacity is constrained to not exceed the capacity associated with the top of the zone or to be less than the capacity associated with the bottom of the zone.
2-19	CGUIDE (IS,IC,MX)	+	If Field 1 is positive, specify reservoir levels for reservoir location (MX) shown on Field 1 of CC card corresponding to the channel capacity (IC) on the CC card for season IS on the CS card. Specify NSEA (CS.1) values. Maximum = 18 values.
		+	If Field 1 is negative, specify reservoir elevations for reservoir location (MX) shown on Field 1 of CC card corresponding to the channel capacity (IC) on the CC card for season IS on the CS card. Specify NSEA (CS.1) values. Maximum = 18 values.
		+	If GS card is used, specify percent of system flood control storage above location ILOCCC on Field 1 of CC card corresponding to the channel capacity (IC) on the CC card for season IS on the CS card. Specify NSEA (CS.1) values. Maximum = 18 values.

*Optional card

ED

5 END OF CONTROL POINT DATA

5.1 ** ED CARD - End of Control Point Data

Required card at end of last set of control point data cards (CP - CG) and just before BF card for first flood.

FIELD	VARIABLE	VALUE	DESCRIPTION
1-10			Not used.

**Required card

6 SPECIFICATIONS FOR TIME SERIES DATA CARDS

Data cards after the ED card represent time series data (except for special cards BF, SS, ZR, ZW and EJ). Data for each flow data set read (consult text for multiflood definition) are bounded by a BF and an EJ card. For any set of flow data (could be NPER monthly periods), the set is preceded by a single BF card. One or more SS and/or ZR or ZW cards may follow the BF card. These cards are followed by a set of IN cards (NPER values of each set) for each control point in the system where inflows are to be specified. Omitted flow data for control points will be assumed as zero unless computed by a ratio of another station (see C1.1). If desired, a set of QA or NQ, etc., (NPER values on each set) for any or all of the control points or reservoirs can be used, followed by an EJ card. The order of the time series cards (IN, QA, NQ, etc.) is not important.

HEC-DSS

The HEC has developed a data storage system (HEC-DSS) and a set of computer utility routines to interact with HEC-DSS to facilitate analysis of water resource data. HEC-DSS stores data in elemental blocks or records representing convenient groups of sequential data or pairs of data defining a relationship. The utility routines that have been developed act as interfaces between HEC's generalized application programs such as HEC-5 and HEC-1 and HEC-DSS or between the data users and the HEC-DSS.

Data stored in the DSS may be plotted or tabulated using the DSPLAY program, or used by other programs for a subsequent analysis (e.g., STATS). Data to be input to HEC-5 (e.g., flows) can be entered into a DSS file using programs such as WAT2DSS (WATSTORE to DSS) and DSSIN (manual entry). Program DSSUTL performs utility functions on the DSS file, (editing data, renaming records, etc.).

The HEC-DSS is currently available to Corps of Engineers offices with HARRIS computers and has been installed on the CDC Cybernet system.

The use of DSS by HEC-5 is controlled by JZ, ZW, ZR, ID and BF cards. The presence of one or more ZW cards will cause HEC-5 to write to DSS. ZW, ID and BF cards supply appropriate information for labelling of data written to DSS. The optional JZ card specifies what location and what variables are to be written. Without the JZ card the program will write to the DSS file regulated flows for all control points and inflow, outflow and end-of-period storage data for reservoir control points. The presence of one or more ZR cards will cause HEC-5 to read data from DSS. Reading data from DSS eliminates the need for the user to supply that same data as part of the time series data.

The HEC-DSS uses "pathnames" to identify data stored in a DSS file. For time series data, information is organized into blocks of data, each block containing data at one location, for one variable over a specific period of time (e.g., 1 month or 1 year). The pathname used to identify the block is divided into six parts, each part separated by a slash "/". The first or the "A part" corresponds to the basin or project name (see example below). The second or "B part" is the location name for the data. The "C part" identifies the data variable (e.g., FLOW, ELEV, etc.). The "D part" gives the beginning date of the time block, and the "E part" gives the time interval between data (e.g., 1DAY), the "F part" is for any additional qualifications needed and it is left for the user to choose (plan labels are a good example of what the "F part" may contain).

Sample Pathname:

/POWER STUDY/RED RIVER/FLOW/01JAN1981/1DAY/PLAN 3A/

When specifying pathname parts on ZW and ZR cards each part is given in free format style, with commas or blanks separating the parts. A pathname part may have embedded blanks, but no leading or trailing blanks.

Writing to DSS. When writing data generated by HEC-5 to a DSS file a ZW card is required in the input following the first BF card. The A and F parts of the pathname are specified on this ZW card in a free format style. An example which would write data to DSS is:

ZW A=RED RIVER, F=PLAN 3A

The A and F parts are the only pathname parts that need to be specified on the ZW card. The B part of the pathname is obtained from the ID card. The C part is provided by the program based on the variables (default or specified on JZ card) to be written. The D and E parts are determined by the program from the time parameters on the BF card. Specific control point locations and data variables to be stored may be specified on the JZ card.

Reading from DSS. Time series data stored in a HEC-DSS file may be read by HEC-5 using a ZR card. The ZR card, which follows the BF card for each flood, indicates which data is to be read from DSS. The A, C, and F parts of the pathnames for the data to be read are specified on the ZR card. The type of HEC-5 time series input data (i.e., IN, QA) must also be specified in the ZR card. Similar to the ZW card, these pathname parts are given in a free format form. For example:

ZR=IN A=RED RIVER, C=FLOW, F=OBS

This would cause IN time series data to be read from DSS for all appropriate control points in lieu of the user supplied IN cards. The A and the F parts, defined on the first ZR card, remain the same until reset by a later ZR card. Field 1 of the BF card must always be set to 2 when reading from DSS.

The B part of the pathname is obtained from Fields 3 and 4 of the ID card, unless blank, whereby Fields 1 and 2 are used. The D and E parts are generated using the time parameters given on the BF card. If data is missing from the DSS file at the beginning or end of the requested time period, the first or last data value is repeated and extended to replace the missing data and a warning message is printed. If data is missing in the middle of a data block, only a warning message is printed, the missing data is assigned the value of -901. If no data exists, a warning message is printed and no data is read into HEC-5. Data is attempted to be read for each relevant control point, unless ZR cards restrict the read to specific control points.

The specific control point form of the ZR card allows the user to read data for only the specific control point indicated on the card using pathname parts different from the default parts. The B part of the pathname may be given if different than the name given on the ID card. The A, B, C, and F parts given on the specific control point form of the ZR card do not become defaults for later ZR cards, they are only used for processing that card. If specific control point ZR cards are used in conjunction with a global ZR card, global parts are used for any parts not given on the specific card. For example:

```
ZR=IN A=RED RIVER, C=FLOW, F=OBS
ZR=IN25 F=PLAN 3A
ZR=IN42 B=BRIDGE PORT, C=FLOW-NAT
```

These cards will cause inflow data to be read at every control point using the parts given on the first ZR card, except at control point 25, where an F part of "PLAN 3A" will be used and at control point 42 where a B part of "BRIDGE PORT" and C part of "FLOW-NAT" will be used.

If data is to be read for only certain control points, specific ZR cards only can be used. For this method, the A, C, and F parts may be set by using a ZR card preceding the specific control point cards with no data type given. For example:

```
ZR A=RED RIVER, C=FLOW, F=OBS
ZR=IN32
ZR=IN105
```

The above example will cause data to be read for only control points 32 and 105. This method should be used when reading from both DSS and user-supplied time series cards or when C1 cards are used to specify inflows.

For HARRIS machines, the names of the DSS file(s) to be used are specified on the execution line of the program HEC5A. If data is to be read and written from the same file, the word "DSSFILE" should be used. If data is to be read from one file and written to another the words "DSSIN" and "DSSOUT" should be used. For example:

```
HLIB*HEC5A,INPUT=SCIN,DSSFILE=SCIDSS
```

or

```
HLIB*HEC5A,INPUT=SCIN,DSSIN=SCIOBS,DSSOUT=SCIPLAN
```

For flow-frequency data, the "DSSFILE" must be specified on the execution line of HEC5B.

On the CDC Cybernet system the DSS input file is TAPE71 and the DSS output file is TAPE72. These files must be explicitly obtained using the "GET" command prior to the HEC5A execution line.

BF

6.1 ** BF CARD - Beginning of Flood (time series data set)

FIELD	VARIABLE	VALUE	DESCRIPTION
1	FLOFMT	0	All time series data (Cards IN-CC) will be read using standard format of 10 fields per card. (First 2 fields of first card are used for identification and date.)
		2	All time series data (Cards IN-CC) will be read using the standard format of 10 fields per card so that MM and DATE are read on the first card and the flows are read starting with the first field of the second card. (This format (2) must be used when reading data from HEC-DSS.) With this format, if the third field of the first time series data card is greater than zero, it will be used as a multiplier for all time series data on remaining cards. Fields 4-10 of the first card are not used.
2	NPER	+	The number of periods of flow data on next set of cards (IN-CC). Maximum value = 2000.
3	NPSTO	0	A "0" is normally used.
4	CNSTI	0	Factor of 1.0 will be used.
		+	Factor which is multiplied times all inflows and local flows on the next IN and NQ cards.
5	FLDAT	+	Date corresponding to the beginning of the time interval of the first flow on the next IN card. The datum is an 8 digit number (2 digits each for year, month, day, hour) such as 54120223 for December 2, 1954 at 11 p.m. For monthly routings the day should be = 01, and the hour = 00. For daily the hour = 00.

**Required card for each flow data set

** BF CARD - continued

FIELD	VARIABLE	VALUE	DESCRIPTION
6	EPER	0	Last computation period will be NPER.
		+	Last computation period desired, if less than NPER. EPER cannot exceed dimension limit (PERS in output) and therefore can be used within the first flood only.
7	IPER.MINPER	+	Time interval in hours (IPER) or minutes (MINPER) between data in all time series data cards (i.e., IN, QA, etc.). For intervals of one hour or longer use integer values of IPER (i.e., 24 for a daily interval, 720 for a monthly interval). For intervals of 60 minutes or less use a decimal point followed by the number of minutes (i.e., for a half-hour interval use .30, for a 15 minute interval use .15).
8	NDAYWK	0, +	A "0" is normally used.
9	ONESUM	0	A "0" is normally used.
10			Not used.

**Required card.

SS

6.2 * SS CARD - Starting Storages[1]

FIELD	VARIABLE	VALUE	DESCRIPTION
0	ID	SS	Card identification characters.
1	MM	+	Identification number (RL.1) of reservoir whose starting storage is on Field 2 of this card.
2	STOR1(M)	+	Starting storage for reservoir MM at time FLDAT on previous BF card (BF.5).[2]

*Optional card

---

[1]These starting storages will override those on the RL card and can be specified for any or all reservoirs by using an SS card for each reservoir.

[2]A ZR card, (ZR=SS) when used, will read in starting storages from HEC-DSS and will write SS card images for HEC-5 to read.

6.3 * ZR CARD - Identification Card for Reading Data from HEC-DSS

Read time series data from HEC-DSS (see Section 6, page 43 for additional description).

CARD COLUMNS	VARIABLE	VALUE	DESCRIPTION
1-2	ID	ZR	Card identification characters.
3-5	Data type	Blank	When this field is blank the ZR card is only used to set the default A and F parts for subsequent ZR cards.
		Data Type	An equal sign and the HEC-5 time series card ID indicating what data type to read from DSS (i.e., =IN or =QA).
6-8	MM	Blank	When no contol point number is specified data will be read for all control points defined in the HEC-5 data deck that required the type of data specified in columns 3-5.
		+	Up to 3 digit CP No. (left justified) as defined on CP card, causes data for only that location to be read from DSS. Any pathname parts appearing on this card will be used only for this current card and will not reset the default values
10+	Pathname Parts		Free form identification of pathname parts. Each pathname part is separated by a comma or space. Unspecified pathname parts will assume default values specified on previous ZR cards, except as noted for specific control points above.

EXAMPLES:

```
ZR=IN     A=POWER STUDY, C=FLOW-LOC INC, F=PLAN A
ZR=IN25   B=BOGGY CREEK, C=FLOW-REG, F=PLAN E
ZR=QA     C=FLOW-RESOUT, F=PLAN C
```

*Optional card

ZW

6.4 * ZW CARD - Identification Card for Writing to HEC-DSS

Write data to the HEC-DSS file. See Section 6 (page 43) for additional description. Locations and variables to be written to the HEC-DSS file are controlled by the JZ card.

CARD COLUMNS	VARIABLE	VALUE	DESCRIPTION
1-2	ID	ZW	Card identification characters.
3-4		blank	Time series data will be written to HEC-DSS.
5+	Pathname Part		Free form identification for A and F parts of the pathname. Each pathname part is separated from other parts by either a space or a comma. Examples: ZW A=POWER STUDY F=PLAN 6C ZW A=BEDROCK CREEK, F=BASE

*Optional card

7 TIME SERIES DATA CARDS

7.1 ** IN CARD - Inflows or Local Flows

Inflows or local flows for NPER(BF.2) periods. See BF.1 for card format for all time series data (IN - CC).

FIELD	VARIABLE	VALUE	DESCRIPTION
1	MM	+	Control point number. Equal to MM for RL and CP cards.
2	DATE	+	Starting date of flow in Field 3 for identification only. Alphanumeric data such as 6 June.
3-NPER	QII(I,M)	+	If ILOCAL(J3.6) is equal to 1, incremental local flows between M and the next upstream control points are read. If ILOCAL = 10 or 15, observed gages are read; and if ILOCAL = 20 or 25, natural flows are read.

NOTE: Repeat IN cards for each control point in turn. IN cards for points not in system are ignored. Where IN cards are not read for a control point, flows are assumed = 0.

**Required card

QA

7.2 * QA CARD - Specified Reservoir Releases

Specified reservoir releases for NPER(BF.2) periods for one or more reservoirs. Same format as IN cards.

FIELD	VARIABLE	VALUE	DESCRIPTION
1	MM	+	Control point number.
2	DATE	+	Identification date (alphanumeric) of start of time series data.
3-NPER	QA(I,M)	0	Reservoir outflows for period I will be determined by computer.
		+	Reservoir outflows, in cfs or m^3/sec for period I, specified by a positive number will be used instead of the computer-determined release. If a release of zero is desired, use .01. If specified release exceeds outlet capacity shown on RQ cards for corresponding storages on RS cards, release will be restricted to the appropriate maximum outlet capacity. Specified releases will not be allowed to draw the reservoir storage below Level 1.

7.3 * NQ CARD - Base Condition Flows

Base condition flows (normally natural flows but can be flows for an existing system) for NPER(BF.2) periods. Natural flows will be computed and printed when these cards are omitted and when FLONAT(J3.4) is set to -1.

FIELD	VARIABLE	VALUE	DESCRIPTION
1	MM	+	Control point number.
2	DATE	+	Identification date (alphanumeric) of start of time series data.
3-NPER	QPREP(I,M)	+	Base condition flows in cfs or m^3/sec used for printout purposes and for expected annual damage base flows.

*Optional card

QD

EL

7.4 * QD CARD - Diversion Flows for Location MM for NPER (BF.2) periods.[1]

FIELD	VARIABLE	VALUE	DESCRIPTION
1	MM	+	Control point number.
2	DATE	+	Identification date (alphanumeric) of start of time series.
3-NPER	DQ(I,M)	0,+,-	Diversion flows in cfs or m^3/sec.

7.5 * EL CARD - Stages for Nonreservoir Location

Stages for nonreservoir location MM for NPER (BF.2) periods. These data can be input only if ILOCAL=0 or 1.

FIELD	VARIABLE	VALUE	DESCRIPTION
1	MM	+	Control point number.
2	DATE	+	Identification date (alphanumeric) of start of time series data.
3-NPER	ELEV(I,M)	+	Stages in feet or meters. Only positive stages can be used.

*Optional card

[1]DR.7 must = -5 for location MM in order to read this QD card.

CC

7.6 * CC CARD - Specified Reservoir Channel Capacities

Specified channel capacities for NPER (BF.2) periods for one or more reservoirs. Same format as IN cards. Positive values which appear on these cards will override the values of channel capacity that are based on CC cards (before the ED card) for the same location (except for monthly variations).

FIELD	VARIABLE	VALUE	DESCRIPTION
1	MM	+	User control point number. Equal to MM for CP card (CP.1).
2	DATE	+	Identification date (alphanumeric) of start of time series data.
3+	CHCAP(I,M)	0	Channel capacity for time period "I" will be the value previously defined by data cards prior to ED card.
		+	Channel capacity for time period "I".

*Optional card

8 END OF TIME SERIES DATA

EJ

ER

8.1 ** EJ CARD - End of Time Series Data

Card read after last card for each time series data set (defined as data between BF and EJ card).

FIELD	VARIABLE	VALUE	DESCRIPTION
1-10			Not used.

9 END OF ALL DATA

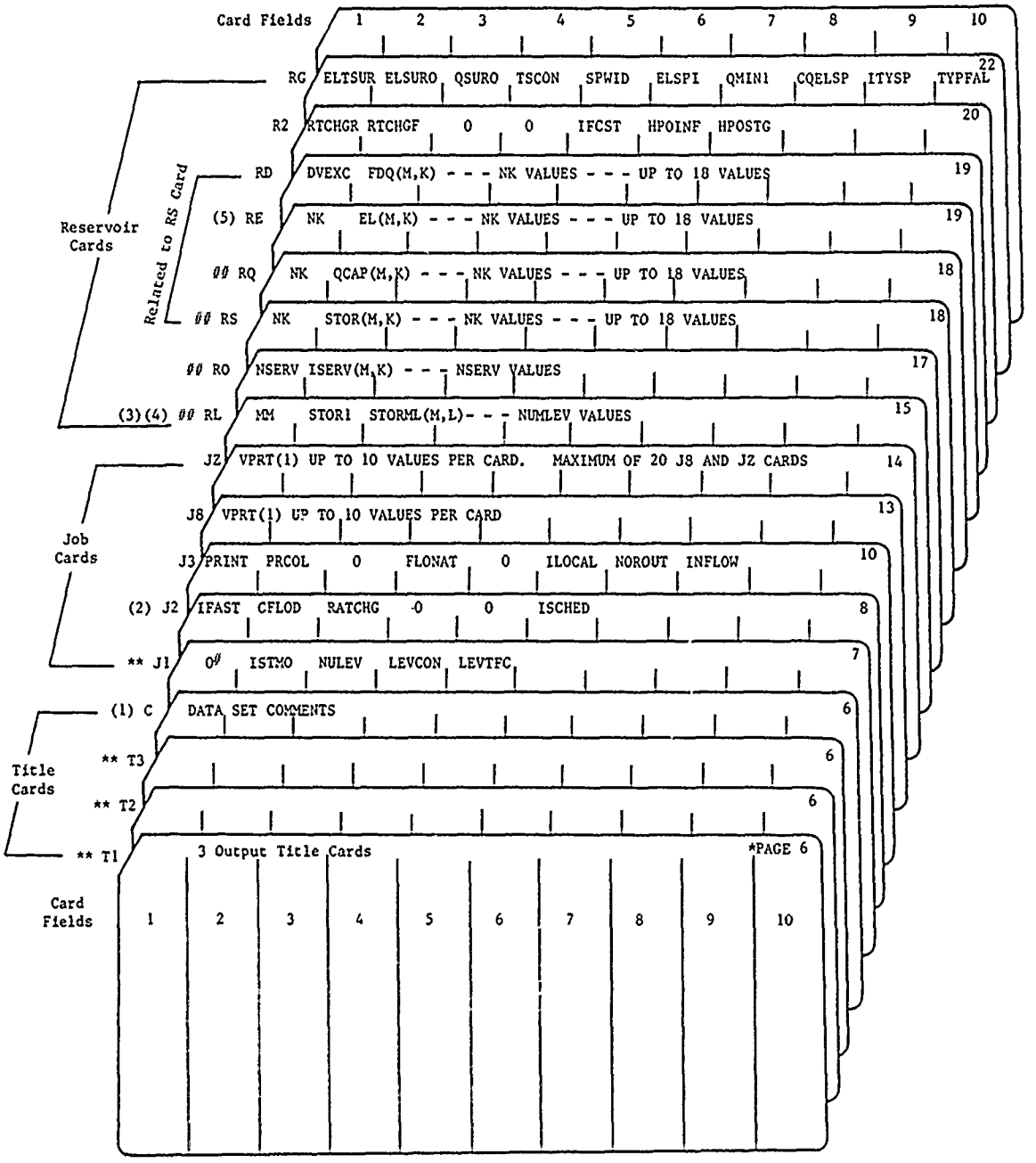
9.1 ** ER CARD - End of All Data (Run)

Card utilized to terminate the run. Program will end with an ER card.

FIELD	VARIABLE	VALUE	DESCRIPTION
1-10			Not used.

**Required card

SUMMARY



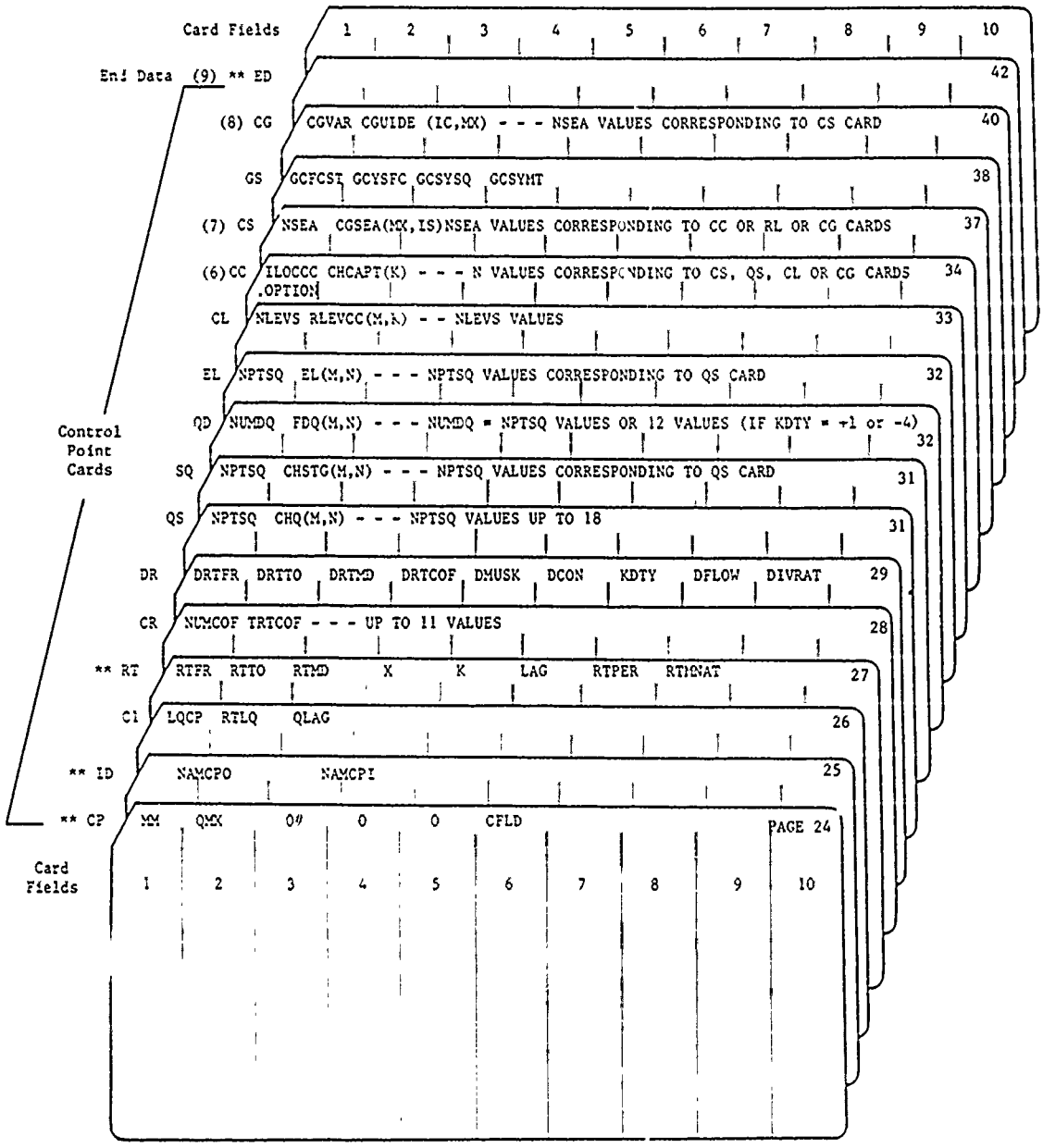
* Page number of Exhibit 8 where card is described.
** Required cards.
\# Where zeros have been shown, they indicate values to be used where nonflood control or multiflood options are omitted (see page 1).
Required cards for reservoirs only.
(1) Comment cards can be located anywhere prior to ER cards.
(2) Cards without asterisks or ## are optional.
(3) Additional RL cards are used for any control point whose storage levels vary monthly or by season (CS card).
(4) Cards RL-CG are repeated for each control point in turn in downstream order.
(5) RE card is required if RG card is used.

HEC-5

IEC-5

of

OF INPUT CARDS



** Required cards.

\# Where zeros have been shown, they indicate values to be used where nonflood control or multiflood options are omitted (see page 1).

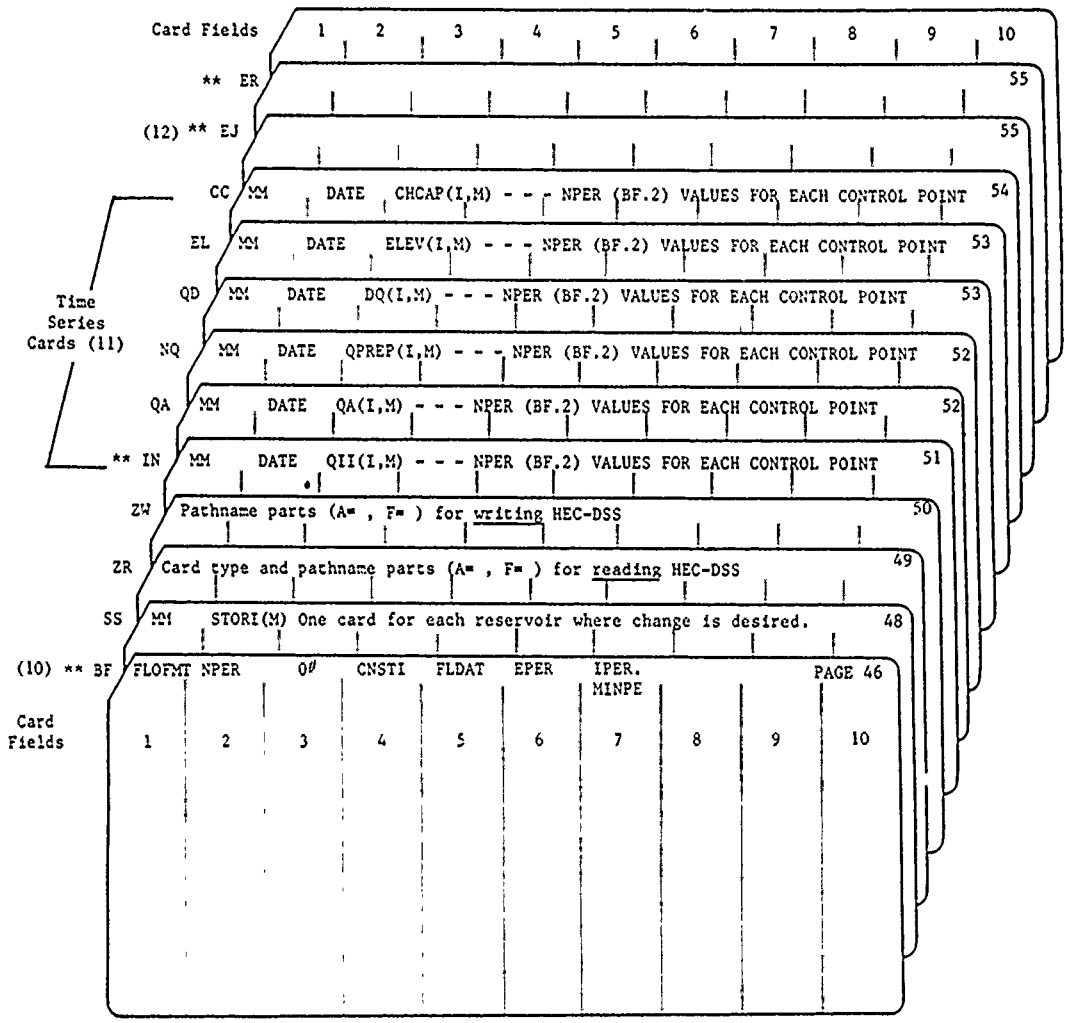
(6) N channel capacities are used corresponding to:
- a. N=12 months of year (OPTION=1).
- b. N=NSEA seasons on CS card (OPTION=2).
- c. N=NPTSQ flows on QS card (OPTION=3).
- d. N=NLEVS levels on CL card (OPTION=4).
- e. N=NSEA seasons on CS card (OPTION=5).
- f. N=NSEA seasons on CS card (OPTION=6).

(7) Up to 18 values except where RL cards vary seasonally (max = 11).

(8) A CG card is required for each channel capacity on the CC card for CC options 5 and 6.

(9) ED card follows last control point.

(2)



** Required cards.

ø Where zeros have been shown, they indicate values to be used where nonflood control or multiflood options are omitted (see page 1).

(10) BF card precedes time series data.

(11) NPER (BF.2) items of flow data are read for each type of card (IN, QA, etc.) until all control points have been read, followed by NPER items for each control point for the next type of card. Maximum number of values = 2000.

(12 EJ card follows last data for each time series set.